

CLAIMS

1. A strand tension apparatus, comprising:

5 (a) a strand delivery mechanism for delivering a moving strand (3) downstream from a strand supply (2);

(b) a strand take-up mechanism (7) positioned downstream from the strand delivery mechanism for pulling the strand from the strand supply;

10 (c) a tension controller (1) positioned between the strand delivery mechanism and the strand take-up mechanism for adding tension to the moving strand (5) as it moves downstream to the strand take-up mechanism, the tension controller including a pair of tensioning plates consisting of a stationary tensioning plate (9) and a second, movable tensioning plate (10), between which plates the moving strand passes; and

15 (d) an adjustable loading force applied to the movable tensioning plate in opposite direction to the movement of the strand generating through geometric restriction a force component perpendicular to the direction of the moving strand; and

20 (e) means to deflect the upstream strand entering the tension controller, generating in the tension controller a deflection force of which a force vector is directed in opposite direction of the adjustable loading force for a reduction of the added tension to the strand.

25 2. A strand tension apparatus according to claim 1, where the added tension to the strand by the compression force between the two tensioning plates is reduced through the force vector of the tension in the upstream strand sufficiently to result in a constant output tension in the downstream strand.

30 3. A strand tension apparatus according to claim 1 or 2, where the movable plate is restricted in its movement to separate from the stationary plate with a major motion-component in the direction of the down-stream movement of the strand.

4. A strand tension apparatus according to any preceding claim, comprising a wedge (21) between the movable tensioning plate and a fixed cam-surface (22).
- 5 5. A strand tension apparatus according to any preceding claim, where the upstream tension vector of the moving strand is deflected before entering the space between the two tensioning plates to generate a force opposing adjustable loading force to reduce the added tension on the movable strand.
- 10 6. A strand tension apparatus according to claim 4, wherein the wedge is fastened to the movable tensioning plate with the thinner portion of the wedge pointing in the opposite direction of the movement of the strand; and where the adjustable loading force pushes the wedge against the fixed cam-surface, forcing the movable tensioning plate against the fixed tensioning plate to apply
- 15 the compression force to the moving strand to increase the downstream tension.
7. A strand tension apparatus according to any preceding claim, wherein the movable plate is restricted in its movement to separate from the stationary
- 20 plate by at least one pivoting link (52).
8. A strand tension apparatus according to claims 4 and 7, comprising at least one pivoting link, fastened on one side to the movable tensioning plate and on the other side at a fixed point; wherein the adjustable loading force pushes the
- 25 movable plate against the fixed cam-surface, forcing the movable tensioning plate against the fixed tensioning plate to apply the compression force to the moving strand to increase the downstream tension.
9. A strand tension apparatus according to claim 4 or 7, wherein at least one
- 30 rolling member is positioned between the wedge and the fixed cam-surface to reduce the friction between these two members.

10. A strand tension apparatus according to any preceding claim, wherein the movable strand is guided around the movable plate through a floating guide which is free to float in the general direction of the moving strand between the tensioning plates.

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11. A strand tension apparatus according to any preceding claim, wherein the adjustable loading force is generated by a spring, or a fluid, or a permanent magnet, or an electro-magnet; optionally including means for applying the adjustable loading force simultaneously to a plurality of tension controllers; and
10 optionally including fine-scale adjusting means able to effect adjustments during operation of individual strand tension apparatus.

12. A method of controlling strand tension in a moving strand, comprising the steps of:

- 15 (a) feeding the strand (3) downstream between a pair of tensioning plates (9, 10) of a tension controller (1) to add drag force to the strand;
- (b) apply a loading force to the tension controller in the direction opposite to the movement of the strand between the tensioning plates;
- (c) generating through geometric restriction of the loading force a
20 compression force on the pair of tensioning plates to generate additional drag on the strand;
- (d) deflecting the strand leading into the tension controller to generate a force-vector of the upstream tension in the strand in the same direction as the movement of the strand between the tensioning plates, which will be
25 subtracted from the loading force for a reduction in the added drag force, based on the magnitude of the upstream tension of the strand.